Electronic Services - Hayward, Ca
M20149X

MODEL 2000-35 BUSINESS RADIO

MANUAL
for
INSTALLATION
and
SERVICE

PACE COMMUNICATIONS
a division of Pathcom Inc., 24049 South Frampton Avenue
Harbor City, California 90710 213-325-1290

PACE 2-YEAR EXTENDED FACTORY SERVICE WARRANTY

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All PACE radio transmitters and receivers are manufactured with guaranteed quality components and workmanship under the following 2-year PACE factory warranty.

PACE Communications Division, Pathcom Inc., warrants each new radio product manufactured by it to be free from defective material and workmanship and agrees to remedy any such defect or furnish a new part in exchange for any part of any unit of its manufacture which under normal installation, use and service, discloses such defect, provided that the unit is delivered by the owner to the factory intact for examination with transportation charges prepaid and provided that such examination discloses in our judgment that it is defective under warranty.

This warranty does not extend to any of our radio products which have been subject to misuse, neglect, accident, incorrect wiring, improper installation or to use in violation of instructions furnished by us, nor extended to units which have been repaired or altered outside of our factory unless authorized.

If any defect in component or workmanship should occur within 90 days from date of user purchase, the owner may return the equipment to the place of purchase or directly to the PACE factory for test and corrective action or exchange at no charge to the owner.

After 90 days, up to 2-years from date of user purchase, the owner may send his PACE equipment to the factory for a complete quality control service program for a single charge of $14. 95. This charge includes return postage and handling charges when payment is sent in with the unit. If during the service test it is determined that any part should be replaced or service work performed to bring the radio equipment up to new product operating specifications, this work will be performed at no additional charge for parts or labor. PACE Communications has the reputation for manufacturing the highest quality communications equipment. We offer this special service program so that each PACE owner may insure that his PACE Communications system is being maintained in top operating condition. To qualify for this special PACE factory service program, the warranty card registration must be returned to the factory within ten days from date of purchase.

This warranty is in lieu of all warrantys expressed or implied, with no representative or person authorized to assume for us any other liability in connection with the sale of our radio products.

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GENERAL INFORMATION

This transceiver is designed for operation in the 25-30 MHz frequency range. The unit is type accepted for operation under FCC Rules and Regulations Parts 89, 91, and 93. Operation is also permissable in the Citizens Radio Service (Part 95). The unit is also DOC approved for operation in Canada. The user is required to be cognizant with and comply with the appropriate Rules and Regulations governing the service being used.

A valid station license and call letters are necessary before operation is permissible The station license is obtained by submitting a properly and fully completed Form Station License Application. After receipt of the license, the user must attach to the transmitter a Form 452-C, Transmitter Identification Card. Anyone may operate a duly licensed transmitter, but the licensee is responsible for violations or infractions of the regulations.

PRE-INSTALLATION

To those readily familiar with transistorized CB radio equipment, there is a tendency to install the equipment without reading the details of the Instruction Manual. However, to avoid equipment damage, a few precautions are necessary.

DO NOT - Attempt to connect the power cord to a primary power source with the power switch on. Determine system polarity before connection. The transceiver is wired for negative ground only. Consult dealer for positive ground connection.

DO NOT - Connect the antenna with the power on. Accidental contact with the rear speaker jacks or transistor on the rear panel will blow the line fuse.

DO NOT - Key the transmitter without the antenna connected.

DO NOT - Replace the fuse with any other type (3 AG 2-1/2 amp).

DO NOT - Attempt alignment of the transmitter to the antenna. Loss of modulation power and efficient operation possibly resulting in transistor burn-out will occur unless the factory prescribed tuning procedure is followed. Maximum efficiency of an installation will result when the antenna has a VSWR of less than 1.5:1. The antenna should be tuned, trimmed, or replaced if necessary to achieve this.

GENERAL DESCRIPTION

This transceiver embodies the latest in high frequency transceiver design techniques. Only the most modern silicon transistors are used throughout.

A separate crystal for transmit and one for receive are used for each channel of operation.

Receiver voltages are zener regulated to maintain sensitivity and squelch operation over a wide input voltage excursion.

All transmitter transistors are oversized silicon units.

The transceiver is designed to operate from a nominal 12 volt DC negative ground source. (Consult your dealer for a special kit of instructions to convert to positive ground.) The transceiver will operate over a nominal input voltage range of 10.5 to 16 volts without damage or serious loss of communication.

TECHNICAL SPECIFICATIONS

RECEIVER

Sensitivity: 10 dB $\frac{s+n}{n}$ @ 40% modulation 0.35 uV

Selectivity: 6.0 KC bandwidth, 4.4 KC minimum, 50 dB bandwidth, 20 KC minimum

Image rejection: major image 55 dB all others 40 dB

Squelch: minimum sensitivity, 0.25 uV, maximum signal stop, factory setting, 20 uV (adjustable)

Noise limiter: series gate approximately 65% clipping level

Audio output: 2.25 watts

TRANSMITTER

Power output: typically 3.00 watts to antenna @ 13.8 volts DC input

Modulation: 85% minimum guaranteed sine-wave 100% average speech

AUDIO

Power output: maximum in receive, 2.25 watts; maximum in transmit, 3.5 watts

Microphone: hi impedance ceramic

Speaker: 2" X 6", 3.2 ohms dynamic

WEIGHT

5 1/2 lbs with microphone

SIZE

2.6" h X 6.9" w X 8.4" d

CIRCUIT BOARD

Glass-fibre

INSTALLATION

Observe that the radio can be mounted either side up in mounting bracket. It is preferable to position the bracket to be near the center of the radio in the final installation.

Select a suitable mounting position keeping the following in mind:

- - Controls must be convenient and visible.
- - The location should not interfere with driver or operators normal functions.
- - The transceiver should not be in the way of heater ducts, air conditioning outlets or direct blast air inlets.
- - The transceiver should be protected from rain and spray. In some commercial vehicles and in marine applications, vertical mounting may prove more convenient. The transceiver may be mounted in any position without performance change.

Connect the power cord to a well regulated source such as an ammeter terminal, ignition accessory terminal or cigar lighter. "Tapping off" of dome or convenient light wires is not recommended as these circuits are usually wired very lightly and some power loss would be encountered. Always install the black wire between the radio chassis and vehicle chassis or system ground to reduce noise pickup.

Install the radio in the mounting bracket and connect the antenna. It is essential for maximum performance that a good antenna be used. See ANTENNAS for a discussion of antenna types.

OPERATION

Operation of the transceiver is simple and self-explanatory to those familiar with two-way equipment.

After power is connected, turn the squelch knob to turn on power. With the volume at about one-half setting and the squelch control counter-clockwise, noise and/or signals should be heard. If the unit is inoperative, determine that the pilot lamp is on, if not, recheck the power connection and line fuse.

The SQUELCH control should be rotated slowly clockwise to silence background noise, or weak or undesirable signals.

The EXT SPKR jack functions in the CB position and can be used to operate on external speaker for receiving purposes. Any suitable speaker of 3 to 8 ohms is satisfactory.

ANTENNAS

No other single part of the system can be as significant a factor in complete success or total failure of performance as the antenna installation.

It is advisable not to experiment but rather to use performance proven antennas. Many new "miracle" antennas appear on the market from time to time, but most of them disappear after a short period. Consult your dealer for the correct type and installation.

Bumper mounts are inadvisable because of their extreme directivity.

The length of the cable from the antenna to the radio is, contrary to popular belief, not important. What is important is that the antenna have low VSWR. If a shortened type of antenna is used, it is mandatory that the VSWR be checked. A PACE 5403 VSWR bridge or similar instrument can be used. If the VSWR is greater than 1.5:1, the antenna must be adjusted in accordance with the manufacturers instructions. If the antenna is a 1/4 wave non-adjustable type, the cable connections and the ground to vehicle at the antenna mount should be checked.

Do not attempt VSWR checks if the vehicle is parked closer than 35 feet from a large fence, metal building, etc.

NOISE SUPPRESSION

When installed in a vehicle whose ignition system proves to be an unusually noisy one, local measures can be taken on the vehicle to reduce such noise. Consult your PACE distributor to determine the most economical method of suppressing the ignition noise. Usually simple suppression of spark plugs may suffice. However, more difficult cases may require special techniques. Sometimes generator and voltage regulator "hash" may be troublesome. Special capacitors and/or complete kits are available depending upon requirements.

Little can be done to reduce noise interference from other mobile sources. Your PACE two thousand series models have the finest noise suppression circuitry available today regardless of cost. Only special and expensive noise blankers can improve upon its noise rejection. "Outboard" noise suppressors available from $20 to $50 on the market cannot improve PACE as noise is already suppressed beyond the capability of such devices. If noise is experienced in Base Station operation from flourescent lamps, motors, etc., suppression devices are available from radio distributors specifically designed for radio noise suppression of these appliances.

MAINTENANCE

No maintenance is required on the PACE other than to give it the care and treatment accorded any quality electronic equipment. The entire radio may be cleaned and waxed to preserve its exterior appearance. Use a rag moistened with water and household detergent and finish with an overall wipe with an alcohol soaked cloth. If the unit is used in dusty conditions the interior can be blown out occasionally with a low pressure air hose or vacuum cleaner. To remove excessive soil on the interior, clean carefully with a soft brush and alcohol and then dry thoroughly before operating.

In the event difficulty occurs, a qualified serviceman with proper instrumentation and service procedures should be engaged. An authorized PACE distributor, warranty station or the factory should perform any service work.

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I. SERVICE INFORMATION

The following procedures contain the necessary information to perform a detailed trouble-shooting analysis and complete alignment of the PACE 2000-35.

The procedures given in this manual assume a general knowledge of communications-type transmitters and receivers and, at least a familiarization with transistors.

A. CHASSIS REMOVAL

Remove all eight screws located on the side of the covers. The bottom and top covers will now lift off.

B. SPEAKER REMOVAL

It may be more convenient to perform service work with the speaker removed if there is a squelch or audio problem. The speaker can then temporarily be plugged into the EXT SPKR (External Speaker) jack. If the problem is in the receiver or transmitter, speaker removal is probably unnecessary.

II. TEST EQUIPMENT

Power source of 13.8 v DC capable of 2 amps either well regulated or semi-regulated and adjustable, and an ammeter. (Or use external ammeter of 0-2.5 amps.)

A. RECEIVER ALIGNMENT

R.F. Signal Generator, capable of tuning 455 KC and 27 MHz CB frequencies, with 30% 1000 CPS modulation. 20,000 ohm/volt multimeter (with AC output function).

B. TRANSMITTER ALIGNMENT

Audio Generator (optional) Oscilloscope 30 mc bandpass or DC coupled scope with detector Wattmeter - 50 ohm, 5 watt.

III. TRANSMIT-RECEIVE SWITCHING SYSTEM

The PACE 2000-35 transmit-receive switching system is semi-electronic. The antenna and speaker circuits are switched by a SPDT relay. The transmitter oscillator and receiver are switched by the same microphone contacts that operate the relay. The antenna circuit is switched

in the conventional manner, and the speaker is also switched with the relay antenna contacts. Shunting of the RF circuit to ground through the audio system is prevented by a pair of isolation RF chokes, RFC 1, and RFC 2. (see figure 1).

When the push-to-talk is in the normal or receive position, the antenna is connected through C1 and C76 to the receiver RF stage while RFC 1 and RFC 2 present a high RF impedance so that no antenna currents will flow into the audio circuit. The speaker is connected across T9 because the RF chokes are essentially zero impedance at audio frequencies. Loss of audio through the antenna or RF stage is prevented by C1 and C76 which are very high impedance at audio frequencies.

When the push-to-talk switch is depressed, the ground side of the receiver is opened, thereby disabling it. The relay coil and transmitter oscillator are energized by completing their ground returns, the speaker is disconnected and the transmitter is connected to the antenna.

Note that + 12v is applied to the transmitter driver and power output stages at all times (through T9). This is possible because these stages draw no current when drive is removed, i.e., the oscillator is off. Receiver audio appears on their collectors, but since they are drawing no current, they appear as a small capacity shunting T9.

IV RECEIVER DESCRIPTION

A.

The PACE 2000-35 series receivers are double conversion superheterodynes. The receiver derives both oscillator injection signals from a single crystal controlled oscillator Q8, Q8 is a high stability impedance inverting oscillator using a parallel resonant crystal. The load capacity for the crystal consists of stray circuit capacity plus C78.

Part of the oscillator output is coupled to a harmonic generator, diode CR2, L3 is then tuned to the third harmonic and is used for the first mixer injection.

The input of the RF amplifier Q1 is tuned by C1, C2, C3, and L1. CR1 is an overload diode which conducts on very strong signals (200,000 uV) to prevent overload of the RF amplifier after the AGC has reached its limit. The output of Q1 is tuned by L2, C8, and C9 and the signal applied to the first mixer Q2. The output of Q2 is coupled to Q3, second mixer, the resulting 455 KHz output passes through a six section filter, T2, through T7. The signal is amplified to a suitable level for detection by Q4 and Q5. Q5 drives a linear voltage-doubler detector consisting of CR4-CR3.

The output of the detector contains the rectified audio and a DC component proportional to the carrier. The DC component is applied through filter network R37-C38 to the AGC amplifier Q6. This positive going voltage turns Q6 on, causing its collector to go toward ground. Since Q1, Q2, and Q4, receive their base bias from the network in the collector of Q6, this negative going voltage reduces their bias and consequently their gains. At maximum signal level, they will be turned completely off.

B. SQUELCH OPERATION

Since the RF amplifier is controlled by AGC, its collector voltage increases as the current decreases because of the DC load resistor R4. This voltage change is amplified by Q7, and Q16. Since Q7 and Q16 are complementary symmetry (PNP-NPN) amplifiers, temperature effect is nullified.

The squelch sensing voltage is taken from the collector of the RF amplifier Q1. With increasing signal strength the base of Q1 moves toward ground cutting off Q1. Because of DC load resistor R4 the voltage at the collector of Q1 increases in a positive direction. Since Q7 is a PNP transistor this positive going voltage cuts it off. The cut off or squelch point is determined by R43, the squelch control. As the control is moved toward the +10 volt supply, Q1 must be

more nearly cut off (requiring a stronger signal) to cut off Q7. With Q7 cut off no current flows in R44 - R45 and this in turn cuts off Q16.

When Q7 is switched on, Q16 is also turned on. Q16 draws current through R52 and R55, When Q16 conducts heavily, the junction of R52 - R49 is almost at ground. The resultant voltage at R49-R50 is insufficient to turn Q9 on and, therefore, Q10 will also be off. With Q10 off, the bias voltage across R54 is insufficient to turn Q11 on. (The current drawn by Q16 is limited by R52 and is insufficient to cause enough voltage crop across R54 to turn Q11 on.) Q11 supplies the b ase current for the audio output unit Q12, and Q12 will also be completely off if Q11 is non-conducting.

The voltage level at which Q7 turns on is determined by R43 the squelch control. R43 and R41 form a "stiff" voltage divider. Q7 will be on when its base voltage is approximately 0. 6 v more negative than the setting of R43. With increasing signal strength, Q1 is turned off and its collector goes positive, thus the base of Q7 will go positive turning it off and unsquelching the audio.

Total radio drain in the squelched condition is less than 40 ma plus the panel lamp current.

V. TRANSMITTER DESCRIPTION

The transmitter frequency is controlled by a modified Colpitts oscillator, using a third overtone series resonant crystal. The oscillator is link coupled to the driver. The driver Q14 is zero biased and no current flows until it is driven. Current will flow around the base-emitter path only when the base driving voltage is positive. The resulting current flow sets up a negative charge on C60 which biases the transistor below cut-off. This is a requirement for Class "C" type operation. When biased in this condition, collector current flows only during time the positive drive voltage peaks exceed the cut-off bias. The driver Q14 is coupled to Q15, the output unit, by a "tee" matching network. The driving voltage at Q15 develops a negative bias across R67 similar to that of the driver. The output of Q15 is coupled to the antenna by a double pi and a harmonic filter C71, L9. For maximum drive under high level modulation, modulator power is applied to the driver Q14 as well as the output stage Q15.

VI. RECEIVER SERVICING

Certain steps and careful observation can help pinpoint trouble before wasteful trouble-shooting effort is expended. In case of a dead receiver the following should be checked.

1. If the "S" Meter is working in a normal manner, i. e., it varies as channels are changed and is moving over the scale, then the receiver is probably OK. Trouble points could be in the audio, speaker, or speaker switching circuit.
2. If the "S" Meter is not working the receiver oscillators will be checked as a normal part of the checkout procedure.
3. In case of a dead audio, check the radio current in unsquelched condition (squelch control ccw) current should be about 850 ma at 13. 8 volts. If not, radio is being held squelched or there is a defect in audio biasing.

A. GENERAL

There is a little reason why a receiver will become badly mistuned, and seldom will it be necessary to perform a complete realignment except after major service work. It is much simpler to use the trouble-shooting method where a problem exists in only one area. It is then possible to check each suspected malfunction without resorting to a complete step-by-step service procedure.

B. OSCILLATOR CHECK

Place a voltmeter at TPI. Voltage should be approximately 1. 0 - 2. 0 volts. Momentarily ground the emitter of Q8 through a . 005 uf or larger capacitor, the voltage at TPI

should jump up. If it does, Q8 is OK. If not, check out circuit and retune L4 for minimum voltage at TPI. Final setting of L4 should be with core in L4 about 1/4 turn out (ccw) from point of minimum voltage at TPI. Injection voltages are shown in Table III.

C. TRIPLER CHECK

When Q8 is not oscillating, voltage at TP 2 is positive. When Q8 and the tripler circuit are functioning properly, TP2 will be 3.0 to 6.0 volts negative.

D. AGC SERVICING

Severe overload distortion, failure of the squelch system or "S" Meter operation may be caused by an inoperative AGC system.

Bias for Q1, Q2, and Q4 is obtained from a voltage divider (R5 - R8). The collector of Q6 is tapped into the top of the voltage divider between R6 -R9 and increasing collector current reduces the base bias on Q1, Q2, and Q4. Positive going voltage from the detector is applied to Q6 base through a filter divider consisting of R37, R70, and C37.

AGC for the second mixer Q3 is derived from the emitter of Q2. Since Q2 emitter goes toward ground this cuts off Q3. In this manner Q3 is the first amplifier to be cut off thereby reducing mixer noise more quickly with small increases in signal. AGC trouble-shooting is simplified by using the voltage chart (Table I). Each stage voltage is given for 0. 100 and 10,000 microvolts signal input.

With no signal, observe that the voltage at the emitter of Q1 is about 3.0-4.0 volts (use V-O-M). Increase signal input and observe that this voltage decreases toward zero at very high signal level. Repeat this test at emitter of Q4. The voltage should be about 0.4 - 0.6 v no signal, and decrease to zero. Repeat this test again at emitter of Q2. This voltage will begin at 1.0 and drop to about 0.8 at maximum signal.

If no voltage change occurs with increasing signal, check the collector of Q6 and observe 7.5 - 10.0 volts no signal. This voltage should drop to approximately 3.5 volts at strong signal. If it does not, check for an increasing voltage at CR4 with increasing signal. This voltage will go to about 10 volts if the receiver circuits are operating properly but the AGC is defective, with correct AGC this voltage should not exceed 6.5 - 8.9 volts. Check Q6 and the circuit from CR4 to Q6. If "howling" or instability occurs at high signal levels, replace Q16.

E. DETECTOR CHECK

Detector diodes CR3-CR4 can be checked easily with an ohmmeter. Using low ohms scale, connect ohmmeter to the junction of CR4-R29 and ground. A reading of several hundred ohms should result; if it is much higher, reverse the ohmmeter leads. If very low (less than 100 ohms), or greater than 1,000 ohms, check the diodes individually.

F. RECEIVER GAIN AND ALIGNMENT CHECK

If receiver is operating, but sensitivity is low, it may only be necessary to peak the high frequency RF circuits. If, however, the receiver is very weak, dead or appears off channel, a full realignment check should be made. Receiver voltages for three levels of input signal are shown in Table I and II.

G. HIGH FREQUENCY CIRCUIT ALIGNMENT

1. Connect 20,000 ohm/volts V-O-M to TP3 (collector Q6). Use 10 v scale.
2. Apply signal to ANTENNA jack and tune for minimum voltage at TP3. Adjust generator for a reading of about 6.5 volts.
3. Adjust T2, T1, L2, L3, and L1 for minimum reading at TP3. Reduce generator output as necessary to keep TP3 at about 6.5 v.
4. Set generator for 0.4 uV and touch-up L2, L1, T8, and T7 for minimum reading at TP3. If TP3 is not 7 v or less at 0.5 uV, turn signal generator off. Rotate squelch control clockwise until receiver just squelches, and slowly bring gener-

ator output up. If the receiver breaks the squelch at 0.35 uV or less, continue with step 5. If it does not, proceed to step 6.

5. Set signal generator to 40% modulation (1000 CPS) and 0.4 uV output. Connect an AC voltmeter (with dB scale) across speaker terminals and adjust to about 1 volt audio output using volume control. Use convenient references such as 0 to +2 on the dB scale. Turn signal generator modulation "off" (do not disturb RF output). The voltmeter must drop at least 10 dB.

6. If IF alignment is necessary, it should be attempted only when an accurate 455 KHz signal source is available. Alignment on other than 455 KHz will cause the radio to be off frequency. If a crystal controlled generator is available, the receiver may be aligned on frequency, but this is a less accurat method unless the crystal frequency is known to be within 0.001. Connect the 455 KHz generator at the collector of Q3 through a 0.01 or larger blocking capaci tor and connect a V-O-M to TP3. Bring the generator level up until the voltage at TP3 begins to drop. Peak up T8, through T3 in reverse order. Disconnect generator and apply signal to ANTENNA jack and perform step 5.

7. Check squelch operation by turning the SQ SENS (not used in all models) pot on the rear panel full counter-clockwise. Connect a signal generator to ANTENNA pack, and turn generator output to zero (or tune off channel). With volume up nearly full, rotate the Squelch Control clockwise to the point that just silences the audio output completely. Bring up signal generator output slowly and observe that the squelch breaks at 0.35 uV or less.

If the squelch does not break, check the DC voltage at CR4-R29. The squelch requires 2.1 - 2.5 volts (measure with VTVM) to operate. If this voltage is less, gain is too low.

If the voltage at CR4-R29 is adequate, check that the collector voltage at TP3 will vary at least 0.4 volts while varying signal generator from zero to 0.35 uV. If it does not, check Q6 and its associated circuitry. If Q6 checks out, check voltage at R4-C10. This voltage varies only slightly, about 0.1 v for a 2 to 1 signal input change, i.e., going from 0.5 uV to 1.0 uV. If R4-C10 voltage appears correct, check voltage at Q7 collector by adjusting R43. The proper values are shown in Tables IV and V. Continue voltage tracing at Q16 and Q10. Use schematic for reference.

H. NOISE LIMITER CHECK

If noise limiter diode CR5 is suspected of being faulty, short it out momentarily. If audio comes through, replace the diode and/or check R29, R30, and C36. To check limiter operation obse rve audio between CR5 anode and ground, clipping occurs at 40-60% modulation.

VII. AUDIO SYSTEM DESCRIPTION

The audio system is an all direct coupled single ended amplifier. The input stage Q9 is an emitter follower giving high input impedance. This high input impedance allows use of a standard ceramic microphone. The standard high impedance ceramic unit possesses better speech charac- teristics than the so called low impedance types. Q9 is biased by a divider string in the collector of Q10 thus providing negative DC feedback around Q9 and Q10. This stabilized DC voltage drives Q11. Resistor R56 in the emitter of Q12 is adjusted to compensate for the difference in beta of Q12. R56 is adjusted to provide about 1 amp current in Q12 during transmit. R57 is then adju: to produce 600-700 ma in Q12 during receive condition.

Squelch operation is obtained by "starving" the divider string in the collector of Q10. The squelch transistor Q16 draws current through a 10 K resistor R52. This prevents any base current from

reaching Q9 turning it off. This in turn shuts off Q10 and the only current then flowing through R53, R54, and R55 is the small amount flowing through R52 to Q16. This is insufficient to turn Q11 on and Q12 will also be off.

A. AUDIO SERVICING

(a) Place the channel selector switch on an unused channel, place a short (use a piece of tinned wire) in the crystal socket for the channel selected and depress the mike key. Total radio current should be 0. 9 - 1. 25 amps.

About 25 millivolts of audio applied to the audio input should produce 80-100% modulation. If this is satisfactory, but modulation is still poor, check the output from the microphone. Normal close talking should produce 15-30 millivolts on a 1 megaohm input audio voltmeter. It should be possible to obtain 150-300 millivolts when whistling loudly into a good microphone.

(b) If audio gain appears to be low, connect an audio generator (150 to 10K ohms output impedance) to the audio input through a 330K ohm resistor. The audio input is conveniently reached at the top of R36, VOLUME. Connect an oscilloscope across T9 (scope is connected to Q12 can at rear panel, and chassis) and apply a 1000 cycle signal. Bring signal level up until clipping starts on Q9. This should occur at less than 40 mV (0. 04v) output from a 600 ohm generator

If current checks are satisfactory, but gain is low or distortion excessive, bridge all by-pass capacitors including C35 with known good units.

If current checks are unsatisfactory, check voltage in accordance with Audio DC voltage chart Table IV.

If voltage at Q10 collector is high, usually Q9, Q10, or a resistor R49 through R54 is defective. If voltage at Q10 collector is correct, but audio is dead or there is very low current, Q11 or Q12 are usually defective. Q11 can be checked by disconnecting the jumper leading to the base of Q12 and connecting a milliammeter between Q11 collector and ground. A reading between 5 and 15 ma indicates the pre-amp and driver Q9 through Q11 are OK.

(c) If Q12 is defective and must be replaced, new values for R56-R57 may have to be selected. After installing Q12, check current drain in accordance with section (a) above. If it is not between 0. 9 and 1. 25 amps, remove R56 and R57. If current level is too low, R56 will have to be decreased in value, or if too high, it will have to be increased. With R57 removed, adjust R56 for 0. 9 - 1. 25 amp current, then select a value of R57 that will drop the current to 0. 65 - 0. 75 amps. This will usually be between 400 and 1500 ohms. After installing R57 recheck current according to section (a) above.

VIII. TRANSMITTER SERVICING

A. GENERAL

To properly align and test the transmitter, a good modulation indicator is more important than any other instrument. There are three satisfactory methods of checking modulation:

1. A high frequency (30 MHz) oscilloscope, which can be directly coupled by a small capacitor to the ANT. jack.
2. A low frequency scope with provisions for direct connection to the deflection plates. A twisted pair, with a 1-1/2 turns link on one end, should be used for coupling. Connect the open end to the deflection plates and then orient the link near the power amplifier coils in the transceiver to obtain a deflection on the screen.
3. A linear detector and a DC scope. This is probably the easiest to use, and the most accurate, unless a high frequency scope is available. A suitable detector is shown in figure 2.

Inexpensive modulation indicators of the meter type have been found to be of irregular accuracy and of no value in checking for parasitics, etc. , and therefore should not be relied upon.

If a high frequency scope is used, connect the probe to an ANT. jack directly through a 20-50 pf capacitor. While transmitting a carrier only, adjust the gain to produce a pattern on the scope of about one-half the usable screen area (see figure 3) . Apply modulation,

and observe the maximum height of the modulated waveform. For 100% modulation EP = 2EM; for 50% EP = 1.5EM, etc. It is more important that the peak(positive) going portion be analyzed since the "trough" or negative going portion will always perform correctly when the peaks are present.

If a low frequency scope using a direct connection to the plates is employed, the same adjustment procedures apply.

B. TRANSMITTER ALIGNMENT. GENERAL

Transmitter adjustment should not be attempted unless very low power, instability or audio distortion is present. In the event of a dead transmitter, follow the tuning procedure CAREFULL Failure to do so may result in excessive dissipation with resultant loss of a driver or output unit. Remember that when a battery or battery eliminator is used, the current supply is nearly unlimited, and it is therefore inadvisable to operate the transceiver without the fused power cord.

To use the DC scope and detector of figure 2A, adjust the position control with the carrier off to place the trace on a reference line near the bottom of the scope face. (See figure 2B). Then feed the unmodulated carrier to the detector and adjust the gain to place the trace in the center of the scope face. It may be necessary to switch the transmitter off and on several times to adjust the trace properly, since on most scopes the position and gain controls will interact.

A 100% modulated transmitter will produce a peak-to-peak envelope equal to twice the shift between the carrier and no carrier traces. (See figure 2C).

When checking modulation, do not over-drive, (whistle into the microphone with increasing loudness) so that maximum modulation is reached without clipping. Talking into the microphone in a normal manner should produce continuous peaks of 80 - 95% modulation.

C. TRANSMITTER ALIGNMENT PROCEDURE

1. Connect wattmeter and scope to ANTENNA jack.
2. Connect V-O-M to TP4 and ground. Use 2.5 volt scale.
3. Key transmitter, (ensure that a crystal is in position and channel selector is in correct position) rotate core in L5 clockwise until meter reading drops, then rotate counter-clockwise to obtain -0.5 to - 0.7 volts. Key transmitter off ar on several times and observe that oscillator starts immediately.
4. Preset the tuning adjustments as follows:
   L6 Slug in approximately flush
   L7 Slug in approximately flush
   L8 Slug in approximately flush

Driver - Adjust L6 to obtain maximum RF output.

Final - Adjust L7 and L8 for maximum RF output. If maximum output exceeds 4.0 watts, rotate driver tuning L6 clockwise to reduce power. Re-peak L7 and L8 for maximum output and further reduce power by rotating L6 clockwise and repeaking L7 and L8 to obtain approximately 3.7 watts outpu L7 and L8 must always be re-peaked after adjustment of L6. After obtaining about 3.7 watts, rotate L7 clockwise to reduce power about 100 MW, rotate L8 counter-clockwise to reduce power an additiona 100 MW.

Check modulation. Steady tone modulation should be at least 80 percent and speech peaks must "hit" 90 percent or greater. If modulation is inadequate, L8 may be rotated counter-clockwise slightly to improve it, but in no case greater than 1/2 turn. Maximum input current at final adjustment shall not exceed 2.1 amperes and power output shall not be less than 3.3 watts.

D. "S" METER

The "S" Meter is in a bridge circuit in the collector of Q6, the AGC amplifier. With no signal, the voltage across the "S" Meter is nearly zero. With increasing signal strength, Q6 conducts, causing the voltage at its collector to go negative (towards ground) with respect to the junction of R65 and R66, causing current flow through the "S" Meter.

E. "S" METER ADJUSTMENT

With the power off, adjust the "S" Meter zero so that pointer is approximately 3 pointer widths below the lower calibration mark. Turn power on and apply an RF signal of 100 u volts. Adjust the calibration control (R66) so that the "S" Meter reads S-9. The transceiver shall not be tilted more than 15^{O} from normal position during this adjustment and test.

IX. TRANSMITTER FAILURE ANALYSIS

In the event that Driver (Q14) or P. A. (Q15) have failed, it should be determined that:

1. CR7, CR10, and CR11 are not defective.
2. The antenna in the normal installation is no more than 2 to 1 VSWR.
3. Input voltage does not exceed 16. 8 v.
4. The transmitter is properly tuned, particularly L6, L7, and L8.
5. The transmitter operates on frequency and without parasitics down to at least 10. 5 volts input.
6. The relay is not affected by vibration.

# # # # # # # # # # # # #

PARTS LIST

All capacitors . 001 to.005 uf are general purpose ceramic, ± 20% tolerance.
All capacitors . 01 uf to . 22 uf are mylar or polyester, ± 20% tolerance.
All electrolytics (1 uf to 1000 uf) are 15 volt except as noted.

Semiconductor - Transistors

Ref. #	Part #	Commercial Equiv.
Q1	13-0065	MPS 6507
Q2	13-0062	MPS 3693
Q3	Same as Q2	
Q4	Same as Q2	
Q5	Same as Q2	
Q6	13-0022	MPS 6514
Q7	13-0061	MPS 6134
Q8	Same as Q7	
Q9	13-0041	MPS 6553
Q10	13-0063	MPS 3694
Q11	Same as Q7	
Q12	13-0014	SJ 2095, 2N3054
Q13	13-0064	MPS 3646
Q14	13-0079	MM 8004
Q15	13-0079	MM 8004

Commercial equivalents are Motorola.

Semiconductors - Diodes

CR1	13-0004	IN 295X (Geranium)
CR2	13-0004	" "
CR3	13-0004	" "
CR4	13-0004	" "
CR5	13-0003	IN 456 (Silicon)
CR6	13-0002	Zener, 10V 2 watt
CR7	13-0017	Zener, 36V 2 watt
CR8	13-0050	Silicon Rectifier, 1 amp
CR10	13-0106	Zener, 68V 2 watt
CR 11	13-0003	Same as CR 4

Coils and Transformers

Ref. #	Part #	Commercial Equiv.
L1	17-0019	Rcvr. Ant. Coil
L2	17-0018	Rcvr. R. F. Amp Coil
L3	17-0025	19 MHz Mixer Coil
L4	17-0017	6 MHz Osc. Coil
L5	17-0028	TX Osc. Coil
L6	17-0021	IPA Tuning Coil
L7	17-0020	P. A. Tuning
L8	17-0021	PA Loading Coil
L9	17-0015	Xmtr. Filter Coil
T1	16-0007	7 MHz IF Xfmr
T2	16-0005	Filter Input FI Xfmr
T3	16-0003	Filter IF Xfmr
T4	16-0003	Same as T3
T5	16-0003	"
T6	16-0003	"
T7	16-0006	Filter Output IF Xfmr
T8	16-0013	IF Output Xfmr
T9	16-0016	Audio/Modulation Xfmr
T11	16-0021	Input Filter Choke
RFC 1	17-0026	3 uh choke
RFC 2	Same as RFC 1	
RFC 4	17-0016	33 uh choke
RFC 5	Same as RFC 4	
RFC 7	Same as RFC 1	
RFC 8	Same as RFC 1	

Miscellaneous

M1	22-0016	Mic. Assembly
	24-0027	Knob, control
RY 1	21-0008	Relay, SPST (enclosed)
	36-0007	"S" Meter
SP1	22-0007	Speaker 3. 2 ohms
J1	27-0060	Ant. Jack
J2	27-0037	Ext. Spkr. Jack
R43	15-0034	Sq. Control
R36	15-0033	Vol. Control

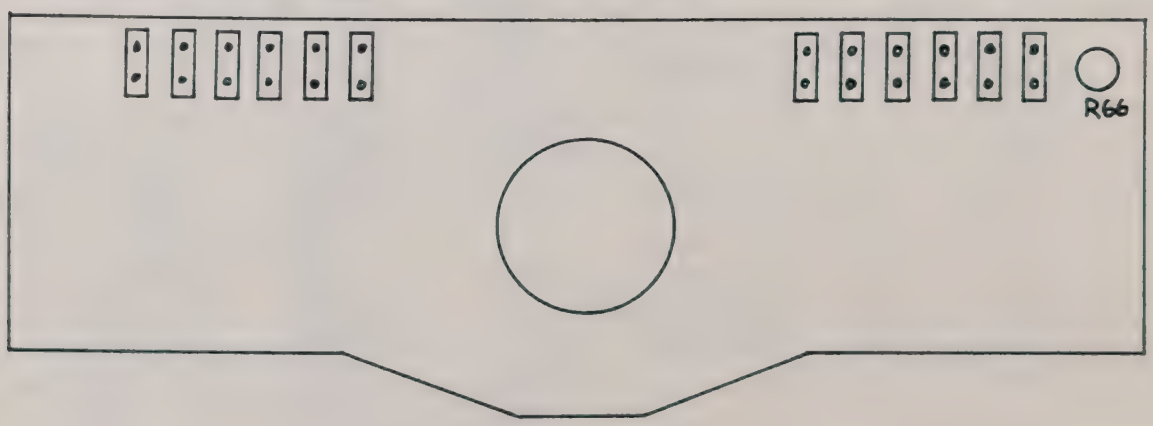
Receiver Crystal:

Xtal Frequency	=	$\frac{\text{Channel Frequency (MHz) } -0.455}{4}$
Mode	=	Parallel Resonance
Load Capacity	=	40 pf
Tolerance	=	$\pm$ .002% (-20^{o} c to $+50^{o}$ c)
Drive Level	=	1 mw
Series Resistance	=	40 ohms (max.)
Holder	=	Hc -25/u
Marking	=	Channel Frequency & "R"

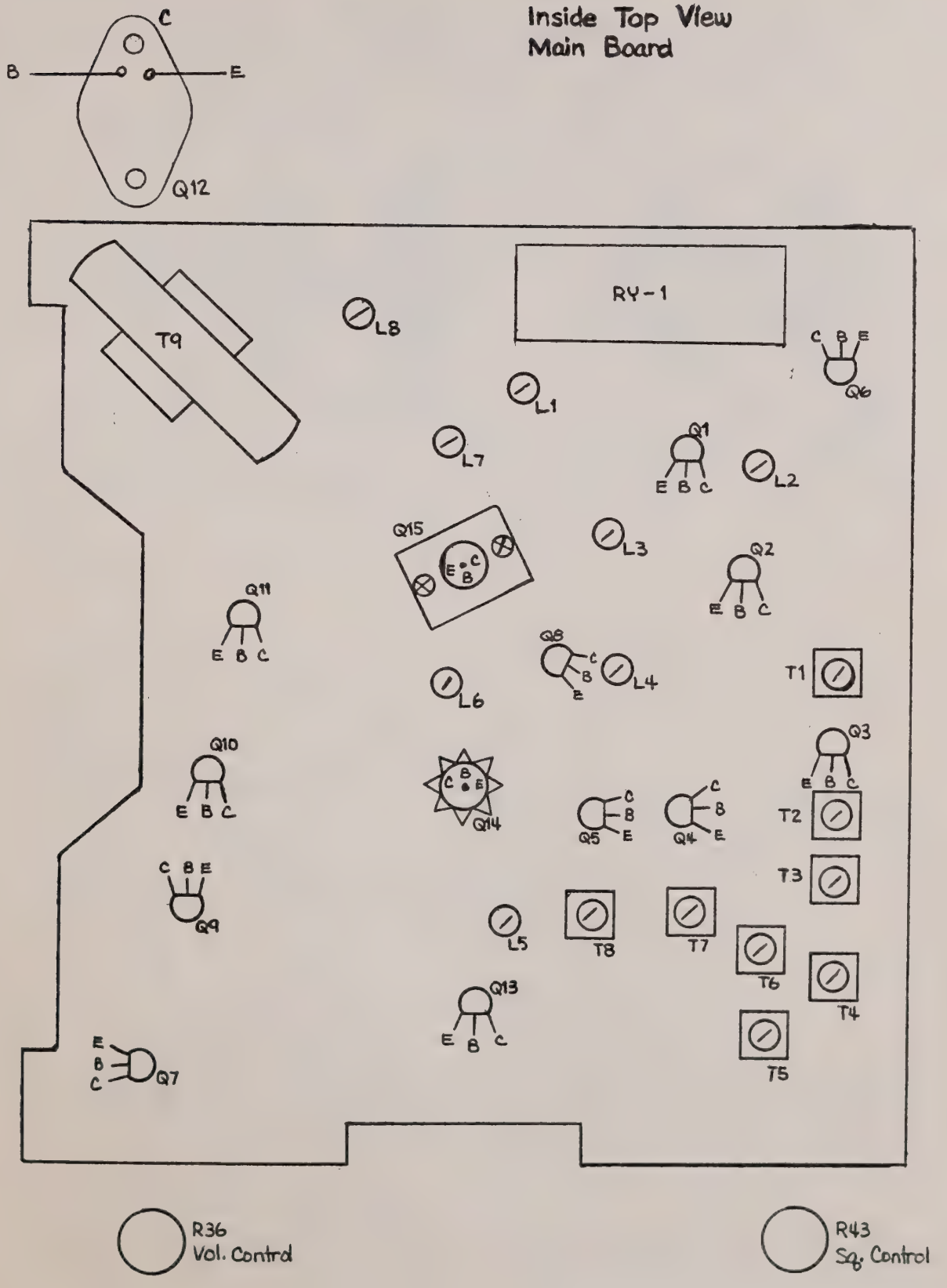
Transmitter Crystal:

Xtal Frequency	=	Channel Frequency
Mode	=	Series Resonsnce, 3rd overtone
Tolerance	=	$\pm$ .002% (-20^{o} c to $+50^{o}$ c)
Drive Level	=	3 mw
Series Resistance	=	30 ohms (max.)
Holder	=	Hc -25/u
Marking	=	Channel Frequency & "T"

2000-35 Crystal Board
Inside Front View



2000-35
Inside Top View
Main Board



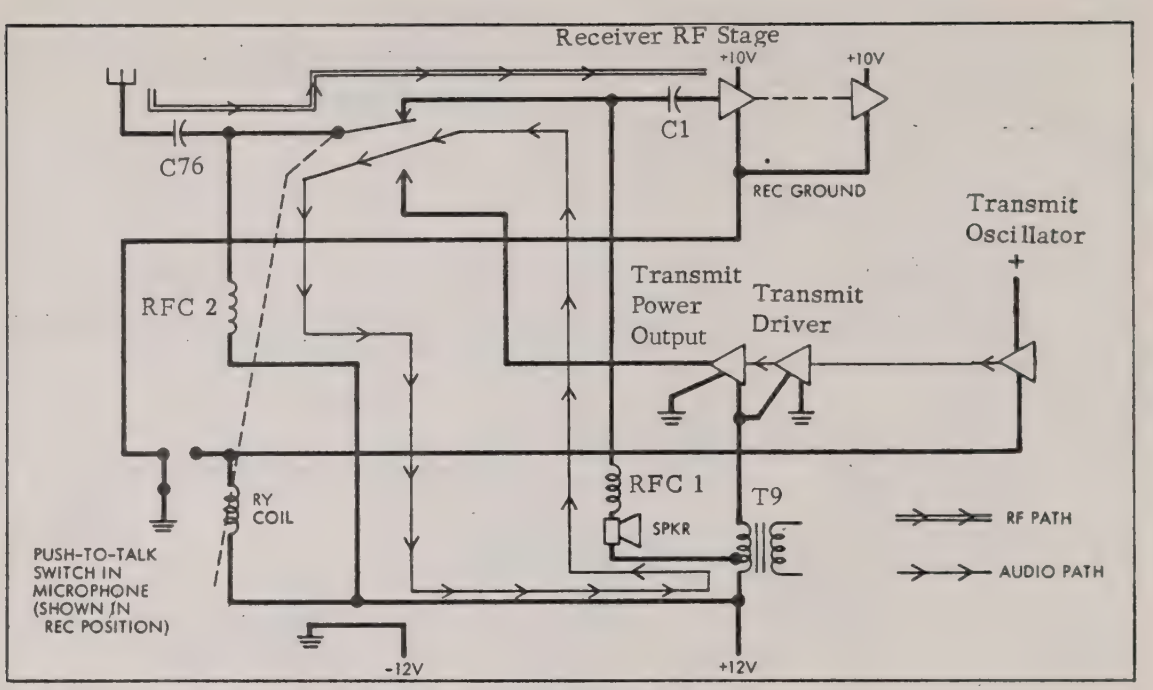


Figure 1. TX and RX Switching

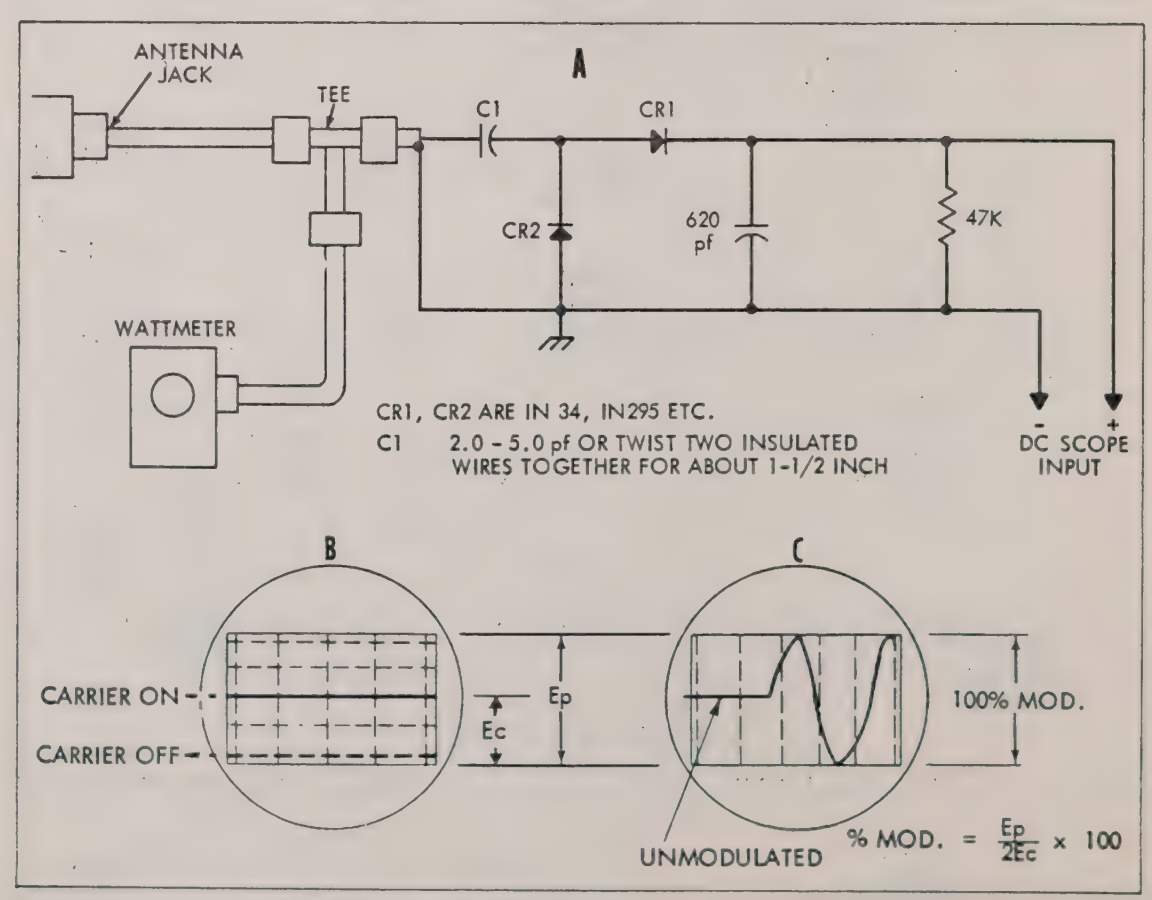


Figure 2. Modulation Detector

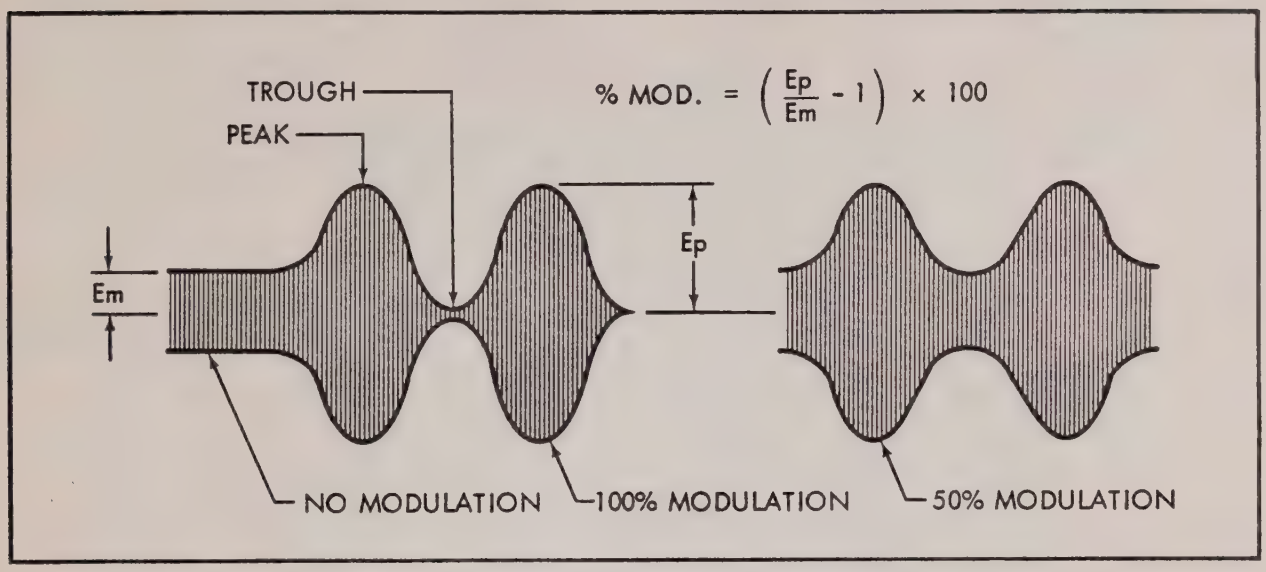


Figure 3. Direct Scope Modulation Measurement

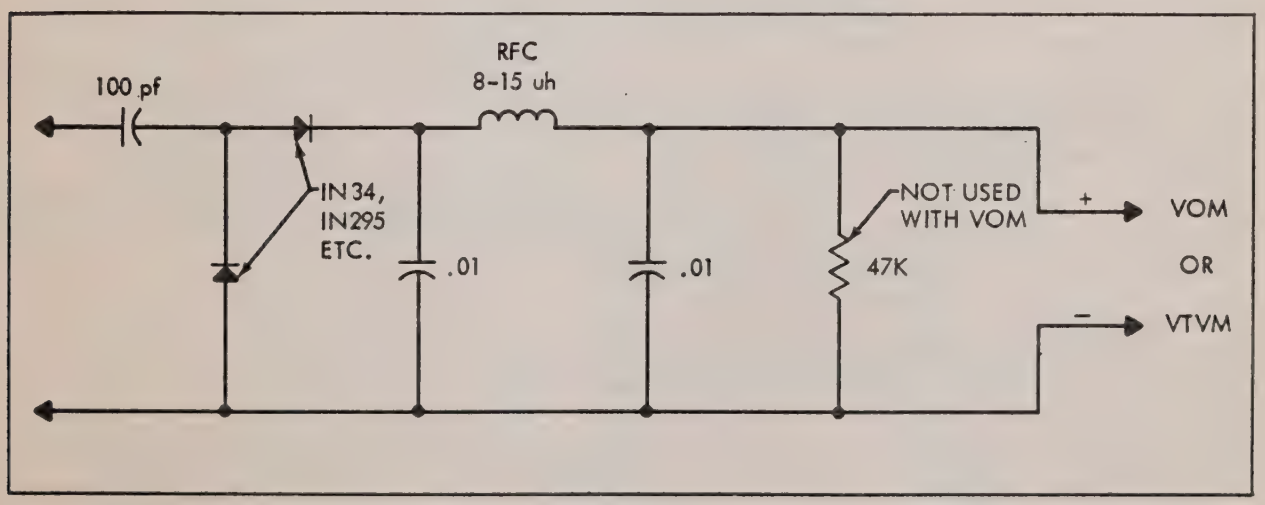


Figure 4. RF Probe

TABLE I

Receiver DC Voltages

	Level	0 uv	100 uv	10,000 uv
Q1	C	8.4	9.1	9.4
	B	4.5	2.5	1.8
	E	3.9	1.9	1.3
Q2	C	6.0	8.3	8.8
	B	1.8	1.0	0.8
	E	1.2	0.4	0.3
Q3	C	9.6	9.6	9.8
	B	1.2	0.5	0.3
	E	0.6	.03	03
Q4	C	4.8	7.9	8.8
	B	1.9	1.0	0.9
	E	1.3	0.4	0.4
Q5	C	8.7	8.7	8.7
	B	2.5	2.5	2.5
	E	1.9	1.9	1.9
Q6	C	9.3	4.5	3.5
	B	0	0.7	0.7
	E	0	0	0
Q8	C	2.3	2.3	2.3
	B	9.2	9.2	9.2
	E	9.7	9.7	9.7

All voltages measured with VTVM (10 megohm impedance) values may vary as much as 20%

****

TABLE II

Detector DC Voltage (at Junction CR4-C38)

0 uV	100 uV	10,000 uV
0-0.2 V	4.5 - 5.0 V	4.0 - 5.5 V

TABLE III

Oscillator Injection Voltages*

	2000-35	2000-35A
Q3 emitter	0.25 - 0.3 V	0.3 - 0.4 V
Q2 emitter	0.05 - 0.07 V	0.2 - 0.3V

* use RF probe w/VTVM

****

****

TABLE IV

Audio DC Voltages

		Unsquelched	Squelched
Q9	C	9.2	12
	B	1.2	0.5
	E	0.6	0.3
Q10	C	5.0	9.5
	B	0.6	0.3
	E	0	0
Q11	C	1.0	0.3
	B	7.5	11.0
	E	8.0	9.0
Q12		13.2	13.7
		1.0	0.3
		0.4	0

****

****

TABLE V

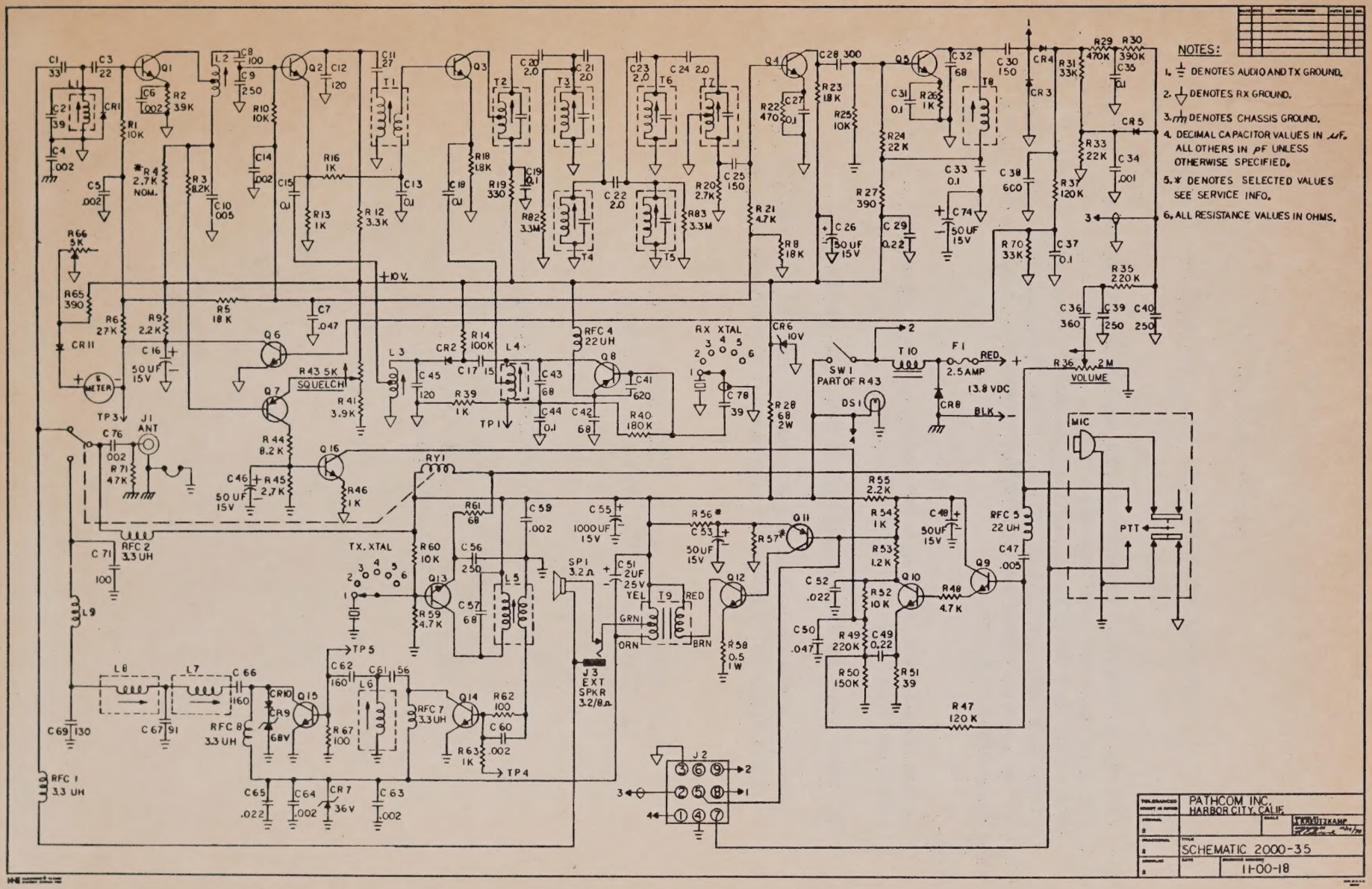
Squelch Amplifier Voltages

		Max. Squelched	Unsquelched
Q7	C	9.5	0
	B	8.8	8.0
	E	10.0	4.4
Q16	C	1.6	5.0
	B	2.2	0
	E	1.6	0

****

****

There is little reason why a receiver will become badly mistuned, and seldom will it be necessary to perform a complete realignment except after major service work. It is much simpler to use the trouble-shooting method where a problem exists in only one area. It is then possible to check each suspected malfunction without resorting to a complete step-by-step service procedure. Refer to the manual for specific areas of trouble.


NOTES:
1. ⏚ DENOTES AUDIO AND TX GROUND.
2. ⏚ DENOTES RX GROUND.
3. ⏚ DENOTES CHASSIS GROUND.
4. DECIMAL CAPACITOR VALUES IN μF. ALL OTHERS IN pF UNLESS OTHERWISE SPECIFIED.
5. * DENOTES SELECTED VALUES SEE SERVICE INFO.
6. ALL RESISTANCE VALUES IN OHMS.
+10V.
SQUELCH
VOLUME
PTT
MIC
RX XTAL
TX. XTAL
SW1 PART OF R43
13.8 VDC
RED
BLK
J1 ANT
J2
J3 EXT SPKR 3.2Ω
SP1 3.2Ω
S METER
DS1
F1 2.5AMP
PATHCOM INC.
HARBOR CITY, CALIF.
SCHEMATIC 2000-35
11-00-18

MODEL 2000-35

BUSINESS/INDUSTRIAL AM Low Band Two-Way Radio

Model 2000-35 is designed for operating frequencies from 25-30 MHz. The standard version has provision for up to 6 channels of operation. The model 2000-35 is type accepted for FCC Part 95, Class D Citizens Operation as well as FCC Part 89, 91, 93, land mobile service and Canadian DOC. When licensing for multiple frequency operation, frequencies should be selected not to have more than a 2 MHz spread for maximum operating efficiency.

NOTE:

If this transceiver has been factory ordered with a single pair, T & R crystals installed, it has been peaked to frequency.

If ordered with multiple channels it is peaked to mid-band.

If ordered without crystals, the unit has been peaked to 27.255 and should be repeaked if operating frequency is greater than 28.000 MHz or below 26.000 MHz.

ALL PACE U.S. MADE PRODUCTS CARRY A FULL 2-YEAR FACTORY SERVICE POLICY.

Be sure to return the enclosed registration to:

PATHCOM Inc., Pace Division
24049 South Frampton Avenue
Harbor City, California 90710